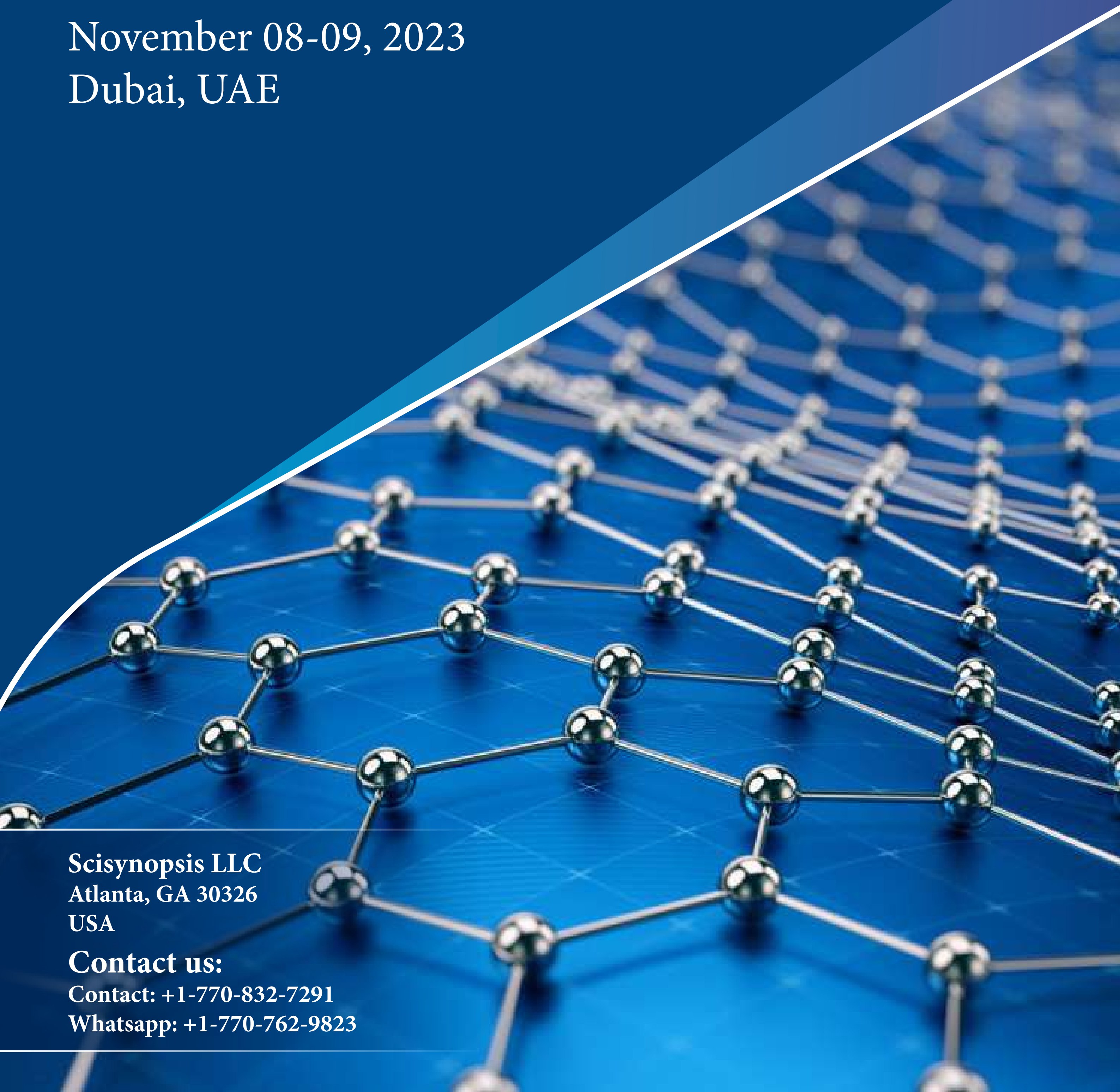
2nd International Conference on

MATERIALS SCIENCE & ENGINEERING

November 08-09, 2023
Dubai, UAE



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Conference Programme

Conference Programme

November 08-09, 2023, Mena Plaza Hotel Albarsha, Dubai, UAE

Day 1, November 08, 2023

Meeting Hall: La Rosa Meeting Room

8.15 - 9.00	**Registrations**
9.00 - 9.30	**Introduction**

Oral Presentations

Session Chair:	**Jae Young Joo,** Korea Photonics Technology Institute, South Korea
Session Chair:	**Cahit Perkgöz,** Eskisehir Technical University, Turkey
Session Chair:	**Vladimir Mitin,** University at Buffalo, SUNY, USA

Sessions: Materials Science and Engineering | Functional Materials | Environmental and Green Materials | Polymer Technology and Plastics | Materials Chemistry | Structural Materials | Composite, Coating and Ceramic Materials | Electronic, Optical and Magnetic Materials|Computational Material Science | Metallurgy | Chemical Engineering| Nanomaterials and Nanotechnology | Advanced Energy Materials| Semiconductors| Polymers & Biopolymers|Nature and Properties of Materials

9.30 - 9.55 **Jose A. Ortiz-Lozano,** Autonomous University of Aguascalientes, Mexico

Title: Structural Use of Fiber-Reinforced Self-Compacting Concrete with Recycled Aggregates

9.55 - 10.20 **Jae Young Joo,** Korea Photonics Technology Institute, South Korea

Title: Compact Measurement of the Optical Power in High-Power LED Using a Light-Absorbent Thermal Sensor and Optical Filter Application

10.20 - 10.45 **Seyed Hamid Tabatabaei,** Foam Ecosolution Innovation Ltd., Canada

Title: Chemical Recycling of Waste Polyurethane Foam Inclusive of Foam Mattress to Recovered (Recycled) Polyol Which We Branded it as Polygreen Polyol for Rigid Foam Production

Group Photo: 10.45 - 10.55

Networking and Refreshments @Beside Meeting Room: 10.55 - 11.30

11.30 - 11.55 | **Sanat Tolendiuly,** Institute of Combustion Problems, Kazakhstan

Title: Synthesis of YBaCuO Superconducting Composites by Combustion Method

11.55 - 12.20 | **Vladimir Mitin**, University at Buffalo, SUNY, USA

Title: Infrared Detector for Tunable IR Focal Plane Arrays Controlled by AI

12.20 - 12.45 | **Tlek Ketegenov**, Institute of Combustion Problems, Kazakhstan

Title: Theoretical and Applied Aspects of Mechanochemistry

12.45 - 13.10 | **Shaimaa Mohammed Moustafa Rohym,** Ahram Canadian University, Egypt

Title: Effect of Coffee on Color Stability and Surface Roughness of Newly Introduced Single Shade Resin Composite Materials

Lunch @ La Mode Restaurant: 13.10 - 14.00

14.00 - 14.25 | **Leonid Chernyak,** University of Central Florida, USA

Title: Impact of Radiation and Electron Injection on Minority Carrier Transport in n- and p-Type Gallium Oxide

14.25 - 14.50 | **Felix Sadyrbaev,** Daugavpils University, Latvia

Title: Heat Transfer Regimes in Nonlinear Media

14.50 - 15-15 | **Kamunur Kaster,** Institute of Combustion Problems, Kazakhstan

Title: The Effect of CuO on the Thermal Properties and Burning Characteristics of Pyrotechnic Mixtures Containing the AN/MgAl

Keynote Presentations

15.15 - 15.55 | **S. Shankar,** National Institute of Technology, India

Title: Performance Evaluation of Emulsified Asphalt Treated Reclaimed Asphalt Pavement Material in Bases

15.55 - 16.35 | **T.D.Gunneswara Rao,** National Institute of Technology, India

Title: Mix Design Aspects of Alkali Activated Concrete Using Fly Ash and GGBS as Binders

Networking and Refreshments @Beside Meeting Room: 16.35 - 17.00

Oral Presentations

17.00 - 17.25 | **Ruslan Safaev,** Almetyevsk State Oil Institute, Russia

Title: Data-Driven Approach to Predict Methods for the Synthesis of MOFs on the Basis of Sorption Properties

17.25 - 17.50 | **Refilwe Jenifer Motsoeri,** University of Johannesburg, South Africa

Title: Process Simulation of Carbonitrothermic Synthesis of Titanium Nitride from Ilmenite

17.50 - 18.15 | **Cahit Perkgöz,** Eskisehir Technical University, Turkey

Title: Exploring the Impact of AI in Nanomaterial Analysis and Optical Waveguide Design

Day 1 Concludes followed by Awards Ceremony

Day 2, November 09, 2023

Meeting Hall: La Rosa Meeting Room

Keynote Presentation

10.00 - 10.40 | **P. Venkateswara Rao,** National Institute of Technology, India

Title: Extraction of Extracellular Polymeric Substance (EPS) from Sludge and Applications

10.40 - 11.20 | **R. Satish Babu,** National Institute of Technology, India

Title: Treatment of Dairy Wastewater with Extracellular Polymeric Substances

Networking and Refreshments @ Beside Meeting Room: 11.20 - 11.45

11.45 - 12.25 | **Rajaram S. Mane,** Swami Ramanand Teerth Marathwada University, India

Title: Self-grown Nanostructures for Energy Storage Applications

Oral Presentations

Session Chair: **Micheline Bejjani,** American University, UAE

Session Chair: **Guang-Ling Song,** Southern University of Science and Technology, China

Session Chair: **Jacob Kleiman,** Integrity Testing Laboratory Inc., Canada

Sessions: Materials Science and Engineering | 3D Printing & Additive Manufacturing | Polymer Technology and Plastics | Metals and Mining Materials | Composite, Coating and Ceramic Materials | Metallurgy | Nanomaterials and Nanotechnology | Polymers & Biopolymers | Advanced Energy Materials

12.25 - 12.50 | **Micheline Bejjani,** American University, UAE

Title: From Food Waste to Biodegradable Useful Products

12.50-13.15 | **Jacob Kleiman,** Integrity Testing Laboratory Inc., Canada

Title: Evaluation of New Material's Surface Modification Processes for Lunar Dust Mitigation in Lunar Environment Conditions

Lunch @ La Mode Restaurant: 13.15-14.00

14.00-14.25 | **Nihan Kosku Perkgöz,** Eskisehir Technical University, Turkey

Title: 2D Materials Growth via CVD: Advancing Optoelectronics and Energy Storage with TMDs, Graphene, and MXene

14.25 - 14.50 | **Guang-Ling Song,** Southern University of Science and Technology, China

Title: Protection of Reinforcing Steel by "Intelligent" Mg in Concrete

Poster Presentations

14.50-15.05 | **Agnieszka Chmielewska,** MaterialsCare LLC, Poland

Title: Hybrid Solid-Porous Dental Implant for Enhanced Drug Delivery Fabricated Using Laser Powder Bed Fusion

15.05-15.20 | **Sergey Fomenkoa,** Institute of Combustion Problems, Kazakhstan

Title: Effect of Mechanical Activation on The Yield of Superconducting Phase of YBaCuO Superconductor Obtained by Combustion Method

15.20 - 15.35 | **Bartlomiej Wysocki,** MaterialsCare LLC, Poland

Title: Post-Processing of Titanium Dental Implant Fabricated Using Laser Beam Powder Bed Fusion (PBF-LB)

15.35 - 15.50 | **Miguel Minhalma,** Instituto Superior de Engenharia de Lisboa, Portugal

Title: Synthesis of MOF/Silica Cellulose Acetate Membranes and Characterization: Removal of Uremic Toxins – Urea and p-Cresil

15.50 - 16.05 | **Abdullah Saad Alsubaie,** Taif University, Saudi Arabia

Title: Characterization and Optical Studies of Hydroxyethyl Cellulose-Copper Oxide Nanocomposites

16.05 - 16.20 | **Marina Knyazeva,** Institute of Physical Chemistry and Electrochemistry Russian Academy of Sciences, Russia

Title: MOF-Based Adsorption Systems for Greenhouse Gas Capture: CO_2 and CH_4

16.20 - 16.35 | **Abuhelo Fadi,** University of Science and Technology Houari Boumedienne, Algeria

Title: Characterization of Mechanical Anisotropy of Aluminum Alloy by Measurement of The Coefficient of Lankford

Networking and Refreshments @Beside Meeting Room: 16.35 - 17.00

Day 1

Materials Science Conference 2023

Keynote Presentation

PERFORMANCE EVALUATION OF EMULSIFIED ASPHALT TREATED RECLAIMED ASPHALT PAVEMENT MATERIAL IN BASES

S Shankar and Mahammad Sameer

National Institute of Technology, India

Abstract:

Emulsions are generally used on top surfaces for coating purposes. Cold mixes in recent years have drawn attention in pavement design as they consume less energy for preparation, mixing and availability at affordable costs. The main difference between cold and hot mix designs is temperature. Preheating temperature is less or not required for cold mix design. These cold mix techniques recycle the existing bituminous roads to form a stable base. Replacement of virgin aggregate with Reclaimed asphalt pavement material is economical. This cold-mix recycling process conserves natural resources, saves energy, and provides a stable base. These recycled bases proved economical and stable to withstand the traffic loads. However, the failure pattern of these mixtures is necessary to study for further improvements. The present study focuses on using RAP material in place of virgin aggregate and treated with emulsion as a base layer in the pavement. To understand the failure pattern of these bases, a study is carried out on different combinations of RAP and VA blends (75%RAP, 50% RAP, 25% RAP, and 100% VA). The study includes the design of the Emulsified Asphalt Treated Base (EATB) using Asphalt Academy 2009 guidelines, moisture sensitivity of the EATB, Resilient modulus of the EATB and fatigue life. From the results, it is observed that for the selected emulsion, the required curing period is higher, which is more than 14 days and also, the additives required to cure the emulsion is required higher than that of the specified, which is more than 1% of cement. It is observed that the Fatigue life of the EATB is more when the percentage of the VA in the mix is more.

Biography

S. Shankar is an Associate Professor in the Department of Civil Engineering, Transportation Division, National Institute of Technology, Warangal. His research interests include Sustainable Pavement Materials, Low Volume Roads, Pavement Management Systems, Marginal and Innovative Materials, and reclaimed asphalt materials. Dr. Shankar has been a Life member of the Indian Society for Technical Education, a Life Member of the Indian Road Congress, a Life Member of the Indian Geotechnical Society and a Life member of the International Society for Concrete Pavements.

MIX DESIGN ASPECTS OF ALKALI ACTIVATED CONCRETE USING FLY ASH AND GGBS AS BINDERS

T D Gunneswara Rao and Andal Mudimby

National Institute of Technology, India

Abstract:

Use of Ordinary Portland Cement in construction is increasing exponentially to cater the needs of the growing population. Cement production is increasing the carbon foot prints and an alternative to replace or partial use of it in the construction sector is indispensable. To address this problem, new binders viz., alkali activated binders are being proposed replacing cement paste in the concrete. This paper presents a methodology for designing such alkali activated concrete. Fly ash and Ground Granulated Blast Furnace Slag (GGBS) are used as binders and Sodium Hydroxide and Sodium Silicate solutions are used as activators. Alkalinity of Sodium Hydroxide is maintained constant throughout the investigation as 4M. Coarse aggregate to fine aggregate ratio proposed based on the concept of maximum dry density of mixed aggregates. A slump of 80mm is considered for proportioning of mix. Based on the proposed methodology mixes aiming a compressive strength of 60MPa and 20MPa are designed and cast. A plot is presented for different ratios of Fly ash to GGBS, keeping the other proportions constant, for different compressive strengths of the concrete mix. The test results indicated that increase in Fly ash to GGBS ratio, decreases the compressive strength of the mix. By adopting suitable proportioning of Fly ash to GGBS, desired strength of the concrete can be achieved. The test results indicated that the proposed methodology is suitable for making alkali activated concrete.

Biography

T.D.Gunneswara Rao is a Professor and Head of Civil Engineering Department in National Institute of Technology, India. His research area interests are Fracture Mechanics of Concrete Structures, Fiber Reinforced Concrete, Torsion of concrete members, Sustainable Construction Materials, Alkali Activated Binders. His Specializations involves in Structural Engineering.

Materials Science Conference 2023

Day 1

Oral Presentations

STRUCTURAL USE OF FIBER-REINFORCED SELF-COMPACTING CONCRETE WITH RECYCLED AGGREGATES

Jose A Ortiz-Lozano[1], Francisco Mena-Sebastia[2], Ignacio Segura[2], Albert de la Fuente[2] and Antonio Aguado[2]

[1]*Universidad Autónoma de Aguascalientes, México*
[2]*Universitat Politècnica de Catalunya, UPC Tech, Spain*

Abstract:

This study is centered around a novel approach in construction, involving a combination of mixed recycled aggregates (RA) to fully replace the usual natural coarse aggregates. The goal is to create a robust, steel fiber reinforced self-compacting concrete (FR-SCC-RA) specifically intended for structural concrete, a key aspect of building structures. Through an extensive and meticulous experimental analysis, the mechanical properties of FR-SCC-RA foundation walls were comprehensively evaluated, encompassing both material characteristics and structural performance. In examining the material properties, an in-depth investigation was carried out using molded specimens and cores extracted from *in-situ* foundation walls constructed in Barcelona, Spain, using FR-SCC-RA. The outcomes of this investigation strongly affirm the advantageous use of RA in concrete production and its subsequent mechanical behavior. Critically, there were no negative effects observed on crucial mechanical parameters such as compressive and flexural tensile strengths, which are vital for the concrete overall strength.

Additionally, the outcomes of full-scale tests reveal an unexpected capacity for the tested concrete slabs to carry loads, surpassing predictions based on test results from core samples. A significant conclusion drawn from this comprehensive research is that FR-SCCRA exhibits great promise for the specific structural category of foundation walls. Notably, the tested slabs demonstrated substantial strength even after developing cracks, a characteristic attributed to the inclusion of specialized structural fibers that enhance the concrete toughness. These insights are transferable to regions governed by similar strict regulations and standards regarding the use of recycled materials and reinforced concrete for structural applications. Beyond its immediate implications, this research contributes to the advancement of the field, potentially enhancing the sustainability and durability of construction projects.

In summary, this study presents a pioneering method in construction by integrating mixed recycled aggregates to create reinforced concrete optimized for foundation walls. Rigorous experimentation confirmed its mechanical reliability and applicability, suggesting its potential for broader use in regions facing analogous constraints. Ultimately, this work underscores the promising possibilities at the intersection of sustainable practices and structural innovation.

Biography

José A. Ortiz-Lozano is a Full Professor at the Autonomous University of Aguascalientes, Aguascalientes, Mexico. He received his BS in Civil Engineering from the Autonomous University of Aguascalientes and his PhD in Construction Engineering from the Polytechnic University of Catalonia, Barcelona, Spain. His research interests include structural engineering, effects of temperature on the mechanical and microstructural properties of concrete, physical and mechanical characterization of cement-based materials, fiber-reinforced concrete, and self-consolidating concrete, among other topics.

COMPACT MEASUREMENT OF THE OPTICAL POWER IN HIGH-POWER LED USING A LIGHT-ABSORBENT THERMAL SENSOR AND OPTICAL FILTER APPLICATION

Jae Young Joo

Korea Photonics Technology Institute, South Korea

Abstract:

LEDs (Light-Emitting Diodes) offer distinct benefits such as luminosity, reliability, and robustness in contrast to traditional lighting methods. Their applications span a wide spectrum, encompassing domains like daily life, healthcare, smart farming, industrial applications, and illumination, ranging from indoor settings to automotive headlamps. Nevertheless, LEDs are vulnerable to thermal deterioration that stems from elevated junction temperatures, particularly in high-power scenarios. Consequently, meticulous scrutiny of both optical power and junction temperature is imperative throughout the entire production process, commencing from the pilot line, to ensure unwavering reliability.

This research introduces a novel approach involving a photo-thermal sensor that employs a sheet-type thermocouple comprised of a photo-absorbent metal film and a thermocouple. The primary goal of this sensor is to facilitate cost-effective qualification during the pilot line phase, catering to high-power luminous devices, and enabling optical monitoring of valuable luminaires, such as UAM navigation lighting or power-intensive automotive headlamps. The sensor's design revolves around detecting the heightened temperature response generated by LED hotspots, stemming from transferred thermal energy and absorbed optical energy. Each sheet-type thermocouple's temperature response is harnessed as a signal output indicative of absorbed optical energy and hot spot temperature, driven by the newly introduced sensor equation.

To validate the proposed thermal sensor, a comprehensive evaluation is conducted. This evaluation entails a comparison between experimental results and measured reference values acquired from an integrating sphere, along with a thermocouple fixed at a junction point. The outcome of the experiment unveils a maximum error of 3% concerning the optical power measurement of 645 mW. This sensor's versatility extends to scenarios like opto-mechanical systems with minimal optical component volume for aircraft or UAM, optimizing étendue squeezing.

Acknowledgement: This work was supported by the Technology Innovation Program (20018828, Development of optical filter for wavelength control and light source module for lighting device) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea)

Biography

Jae Young, Joo has been working in Korea Photonics Technology Institute for the last 15 years. He has over 15 years' experience in illumination optical system design and laser application. Joo has undertaken various studies of a laser fabrication engineering and laser interaction with material. He has developed various type of plastic optics for illumination and manufacturing process of plastic optics related to Solid Sate Lighting (SSL). His research spectrum is centered on core technology in mechatronics and sensors applying to SSL and varied from general lighting to automotive and laser machining. Those works were all started from material science and engineering for proper application. He also has a special experience on Korea-Qatar lighting project focusing on NEMA area. His functional, delivery and leadership roles range from engineering, project management, consulting of illumination and lighting firms, business development based on management of technology.

CHEMICAL RECYCLING OF WASTE POLYURETHANE FOAM INCLUSIVE OF FOAM MATTRESS TO RECOVERED (RECYCLED) POLYOL WHICH WE BRANDED IT AS POLYGREEN POLYOL FOR RIGID FOAM PRODUCTION

Seyed Hamid Tabatabaei, Mohsen Nicknezad, Baharak Norouzi, Farzaneh Safavi and Ali Rajaei

Foam Ecosolution Innovation Ltd., Canada

Abstract:

Foam Ecosolution Innovation, is a Canadian company, based in Vancouver, BC, Canada. The company is founded for the purpose of bringing to market its proprietary chemical recycling technology which addresses the problems relating to the disposal of waste mattress polyurethane (PU) foam and any other PU foam in general. Currently, the vast majority of PU foam materials including mattress are largely produced from petrochemical feedstocks. They are produced from non-renewable sources, emit significant greenhouse gas during manufacturing and are difficult to recycle at end of life, also are very high price. Almost 90% of the waste or scrap polyurethane foam go into landfill disposal and result in many negative environmental issues. Our recycling solution produces a valuable recovered polyol, which will be used in the manufacturing process of rigid polyurethane foam products, and helping in offsetting the high cost of petroleum-based virgin polyols. As the main purpose, the company will offer a multi-level waste processing unit that utilizes advanced chemical technology and processes designed to break down synthetic waste mattress PU foam to a value-added product; Polygreen Polyol, in a controlled and efficient manner and environmentally friendly. The company is also aiming to recycle waste polyester plastic materials as well. The system incorporates glycolysis chemical reaction to treat waste PU foam and polyester plastics to produce Polygreen Polyol that can be used mainly in construction industry as rigid insulation products. Foam Ecosolution Innovation has successfully passed semi scaled laboratory demonstration (7-liter reactor), which has shown good chemical conversion to produce recycled Polygreen products. The scaled-up lab reactor has been set up in such a way to resemble all required parameters for large scale commercial production in size of 5 Metric/ton per 8hr shift. We are at the point to initiate the registration of two IP Patent for our chemical reaction process.

Biography

Seyed Hamid Tabatabei is an Associate Professor and senior research scientist at the Islamic Azad University of Tehran, Iran. He holds a BSc from Tehran University in Applied Electrical Engineering, and obtained his MSc in Mechatronics and PhD in Advanced Electrical Engineering-Waste Control & System from the Islamic Azad University of Tehran, Iran. His area of research is in chemistry martials and polymer, also medical material and function, with a focus on the production and development of novel materials from any recycled plastic, and foam waste resources. He has designed and conducted several projects, which resulted in couple of scientific research publications. He also developed a recycle plant for PET recycling and managed that plant for couple of years. As the Research and Development manager at Foam Ecosolution Innovation Ltd, Hamid's focus is on reprocessing and chemical recycling of polyurethane foam waste materials into value-added polygreen polyol products and formulating new generation of PU materials with the possibility to be used in different industries inclusive of insulation application; furthermore, Dr.Tabatabei and his team are initiating to register two IP Patent for our chemical reaction process.

SYNTHESIS OF YBaCuO SUPERCONDUCTING COMPOSITES BY COMBUSTION METHOD

Sanat Tolendiuly[1,2], Sergey Fomenko[1] and Sovet Aigerim[1,2]

[1]*Laboratory of SHS -New Materials, Institute of Combustion Problems, Kazakhstan*
[2]*AUPET named G. Daukeev, Kazakhstan*

Abstract:

The physical properties of high-temperature superconductors mainly depend on the synthesis methods and technological aspects of sample preparation. Today, the main efforts of scientists from all over the world are aimed at reducing costs and time in obtaining superconducting materials with desired properties. The purpose of this study is the synthesis of high-temperature superconducting materials based on Y-Ba-C-O and the study of their properties. A series of experiments were carried out and prototypes were obtained by combustion in two stages: in the atmosphere and in an oxygen environment in a muffle and tube furnace, respectively. In this work, the initial powders were thoroughly mixed, ground, and calcined in air at 910°C–950°C for 6 to 12 hours in a muffle furnace in a normal atmosphere. The powders were then pressed into the form of granules. To obtain samples fully saturated with oxygen, the samples were annealed in an oxygen flow for 6–12 hours at a temperature of 900°C–930°C, followed by slow cooling to room temperature. The effect of the ratio of initial components (Y_2O_3, BaO, CuO powders), holding time, and annealing temperature on the formation of a useful superconducting phase (Y_{123}) in the synthesized samples was studied. It has been established that the initial ratio of components, the annealing temperature, and the holding time have a direct effect on the qualitative and quantitative formation of the superconducting phase. The chemical, phase composition, and morphology of the obtained samples were studied in detail by XRD and SEM analysis. The optimal result (the maximum yield of the $YBa_2Cu_3O_{7.34}$ superconducting phase in the Y-Ba-Cu-O system) was obtained at a temperature of 910°C-920°C by holding time from 6 to 8 hours.

Acknowledgement: This research has been funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19677755).

Biography

Sanat Tolendiuly is an Associated professor, the leading researcher of laboratory of “SHS -new materials”, Institute of Combustion Problems, Kazakhstan. He has over 14 publications that have been cited over 30 times, and his publication H-index is 3 and has been serving as an editorial board member of many reputed Journals in Kazakhstan, Russia and Turkey.

INFRARED DETECTOR FOR TUNABLE IR FOCAL PLANE ARRAYS CONTROLLED BY AI

Vladimir Mitin, S Tulyakov, G Biswal, M Yakimov, V Tokranov, S Oktyabrsky, and K Sablon

University at Buffalo, SUNY, USA

Abstract:

Artificial Intelligence (AI)-based object recognition in the thermal infrared (IR) spectrum can be enhanced by capturing radiation signals in multiple spectral intervals. In this work, we performed a proof-of-concept design of an adaptable thermal imager based on asymmetrically doped double quantum well (ADDQW) sensors, which can efficiently capture multi-band images in the future. To build the background for new cameras we developed technology for ADDQW tunable infrared detectors based on GaAs/AlxGa1-xAs heterostructures. Controlling the doping in one of the GaAs quantum well (QW), the barrier thickness between coupled QW pairs, and the Al fraction in the AlxGa1-xAs barrier constituting a 25-period ADDQW detector, we can adjust the interval of the tunability of the detector. As in a conventional QWIP, the GaAs well width and the Al content in the AlxGa1-xAs barrier determine the expected energy of absorbed photons. The thickness of the barrier between the two QWs of the same width determines the magnitude of splitting of the ground level as well as the level for the transition to. The level of doping of the right well determines the built-in field between two wells caused by the transition of some electrons from the right to the left well. Relative population of two wells is controlled by magnitude and polarity of the applied voltage. We design, grow and characterize detectors with responsivity band tuning by at least 3 microns in the interval of 8 to 12 micron and 5 to 8 micron by the applied bias within +/- 3V. To demonstrate the advantage of AI control of the band of the sensor array we performed experiments on our collected images containing persons and cars. Fusion of object recognition results obtained in different channels separately gives some improvement over the use of a recognizer with single-channel full-spectrum images.

Biography

Vladimir Mitin is a SUNY Distinguished Professor at the Department of Electrical Engineering, University at Buffalo (UB), the State University of New York (SUNY), NY, USA. He was the Chair of the Electrical Engineering Department of UB for two terms (2003—2009). He is a Fellow of IEEE, APS, Optica, SPIE, AAAS, and IoP. His research interests include: Nanoelectronic and Optoelectronic Devices and Materials; Transport and Noise in Heterostructures, Quantum Wells and Quantum Wires; Material Characterization; Heat Dissipation in Low-Dimensional Structures and Devices; Photodetectors, Terahertz Generators and Detectors, Graphene Devices. He has authored and coauthored more than 310 peer-reviewed scientific journal papers and book chapters, 12 books, and holds 12 patents. His papers cited more than 7,500 times, his Google H index is 42 and D index is 32. 23 of his PhD students have successfully completed their dissertation. He was and is a member of organizing committees of many national and international conferences.

THEORETICAL AND APPLIED ASPECTS OF MECHANOCHEMISTRY

Tlek Ketegenov, R Nadirov, K Kamunur and A Batkal

Institute of Combustion Problems, Kazakhstan

Abstract:

Mechanochemical treatment is one of the modern promising directions of the chemical and technological processes of obtaining a new substance due to the transformation of mechanical energy into chemical and physical processes. The peculiarity of the state of solid matter as a result of intensive mechanical action is determined not only by its destruction, i.e., dispersing and obtaining a powder material with a high new and active surface, but also by the accumulation of defects in the entire volume of particles, which increases their reactivity.

This report presents the results of several years 'research on the theoretical and practical area of mechanical syntheses consisting of inorganic and organic components obtained by a team of laboratory mechanochemistry and materials science from the Institute of Combustion Problems (Kazakhstan).

The report presents general ideas about mechanical processes and the phenomena accompanying them. The main provisions of structural rearrangement and modification of the surface of dispersible particles and the influence factors on the mechanochemical treatment of materials are considered. It discusses some issues related to the course mechanical activation processes, considering the shape of milling bodies and layer thickness of dispersible material.

Further, using the example of several natural materials, it is shown how mechanical treatment can radically change their structures and properties. The results of the synthesis of building materials, fillers for paint and varnish products, pyrotechnics, and rocket fuels are presented.

Acknowledgement: This research was funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant number: BR18574084).

Biography

Tlek Ketegenov represents the "Institute of Combustion Problems" (Kazakhstan). He was the head of work on the creation of chemically resistant materials: powders, ceramic tiles, concrete, coatings, coatings for pipelines, and other technological equipment. During the same period, research was conducted on developing new sorbents to purify water from organic contaminants. Since 1995, he has worked in chemistry, solid-state physics, and mechanochemistry. His research is devoted to establishing fundamental laws in fast chemical reactions during mechanochemical processes, identifying the basic principles of solid-flame combustion of high-energy propellants mixtures, the interaction of grinding material with the substance being ground in mechanochemical reactors, as well as the development of new technological solutions for the production of several materials and products for functional purposes.

EFFECT OF COFFEE ON COLOR STABILITY AND SURFACE ROUGHNESS OF NEWLY INTRODUCED SINGLE SHADE RESIN COMPOSITE MATERIALS

Shaimaa Mohammed Moustafa Rohym

Ahram Canadian University, Egypt

Abstract:

Objective: To evaluate the color stability and surface roughness of a novel supra-nano filled esthetic resin composite employing structural color technology.

Methods: sixty samples were randomly allocated into two main groups (n=30) according to the composite resin used: Group O: (Omnichroma) samples and Group V: (Venus Peral) samples. Each group was then divided into two subgroups (n=15): group O1 and V1: samples immersed in coffee. Group O2 and V2: samples immersed in distilled water. Color changes (Δ E) and roughness values (Ra) were evaluated at baseline, first, and 14th days of immersion. The color change was assessed using Vita Easyshade V, while surface roughness was assessed using a profilometer and Atomic Force Microscope (AFM). Data were collected and statistically analyzed using two-way variance analysis (ANOVA) and Tukey's post-hoc test ($p < 0.05$). Results: Group O1 and V1 recorded the highest Δ E ($P = 0.0002$, 0.001, respectively) and Ra values ($P < 0.001$) with no significant difference between both materials at 14 days.

Conclusion: Single shade resin composite with innovative chromatic material technology has dramatic color change and surface roughness that sacrifice esthetic success.

Biography

Shaimaa Rohym was born and raised in Cairo, Egypt. Shaimaa built her history by merging her area of activities, knowledge and professional values. She received her bachelor degree of dentistry from Cairo University (2005). She had her Diploma's degree in Endodontics (2008). Shaimaa attained her Masters & Doctorate Degree in Esthetic & Restorative Dentistry from Cairo University (2013, 2020 respectively). She gained her practical experience starting from private clinical practice (since 2006) then work as a consultant in Air-Force Specialized Hospital (2014-till now). Also, now beside her teaching position in restorative dentistry to undergraduates & postgraduates students, she also works as a director of internship Program since 2022-till now.

IMPACT OF RADIATION AND ELECTRON INJECTION ON MINORITY CARRIER TRANSPORT IN n- AND p-TYPE GALLIUM OXIDE

Leonid Chernyak

University of Central Florida, USA

Abstract:

This work summarizes research focused on the impact of various types of radiation and electron injection, from either low energy electron beam or due to forward bias, on minority carrier transport in n- and p-type Gallium Oxide. In Ga_2O_3, once bipolar devices become available, minority carrier transport (diffusion length) will be of primary importance. Minority carrier diffusion length defines performance of bipolar devices such as p-n junction diodes, bipolar transistors, and p-i-n detectors. One of the major issues in the current ultra-wide band gap materials technology, is the low diffusion length of minority carriers, partially due to dislocation scattering. It has been shown, however, that electron injection in n- and p-type Gallium Oxide results in a significant increase of the minority carrier diffusion length, even after its deterioration due to exposure to alpha- and proton-irradiation. Furthermore, post electron injection diffusion length in irradiated material exceeds that in Ga_2O_3 prior to irradiation and injection. The root cause of the electron injection-induced effect is attributed to increase of minority carrier lifetime in the material due to non-equilibrium electrons trapping on native point defects. It is thus concluded that the electron injection is capable of “healing” the adverse impact of radiation on ultra-wide band gap materials and can be used for control of minority carrier transport and, therefore, bipolar device performance.

Biography

Leonid Chernyak received his PhD in Physics of Semiconductor Materials from Weizmann Institute of Science (Israel) in 1996. He spent several years as a Research Associate in the Departments of Electrical Engineering at Colorado State University (Fort Collins, Colorado, USA) and Texas Tech University (Lubbock, Texas, USA) (1996-1997) and at Intel Corporation (1997-1999) as a member of technical staff. He joined UCF in 1999 where he is a professor.

HEAT TRANSFER REGIMES IN NONLINEAR MEDIA

Felix Sadyrbaev

Daugavpils University, Latvia

Abstract:

The efficient thermal conversion of biomass into heat requires mathematical modeling. In the presence of radial symmetry in a reactor, the mathematical analysis leads to nonlinear boundary value problems for ordinary differential equations. The boundary conditions for the second-order differential equations involve an unknown function and/or their derivatives. The nonlinearity in the equation may be exponential and may contain singularities. Different solutions to boundary value problems are associated with different combustion regimes. Usually, equations depend on several parameters. The typical questions to be answered are about the existence of a solution and estimations of the number of solutions.

Biography

Felix Sadyrbaev has his expertise in mathematical modeling, boundary value problems for differential equations, studying biomathematics and complex networks. Both quantitative and qualitative methods are used. Scientific advisor of more than ten doctorate students. Nine Ph.D. theses were successfully defended. The author of Scholar 173 articles, Scopus 89 articles. H-index 12 by Research Gate. Editor in a number of mathematical journals. Active lecturer in international scientific events. Participated in several International Congresses of Mathematics. Delegate of General Assemblies of the International Mathematical Union in Bangalore (2010) and Sao Paulo (2018). IMU GA 2010 (Bangalore), 2018 (Sao Paulo).

THE EFFECT OF CuO ON THE THERMAL PROPERTIES AND BURNING CHARACTERISTICS OF PYROTECHNIC MIXTURES CONTAINING THE AN/MgAl

Kamunur Kaster, Ketegenov T A , Nadirov R K and Batkal A

Institute of Combustion Problems, Kazakhstan

Abstract:

Despite its effective use in civilian and military technology, ammonium nitrate (AN) remains the object of numerous studies in creating new pyrotechnics, explosives, and gunpowders. Although ammonium nitrate produces clean and smokeless combustion products, its use in fuels is limited by several factors: sensitivity to initial temperatures and pressures, low combustion rate, and the need to use special catalysts. Therefore, to improve the energy characteristics of gunpowders based on ammonium nitrate, metalized additives, mainly powdered aluminum, are introduced into their composition. Aluminum provides a high calorific value of composite fuel. However, its ignition is also tricky due to the protective oxide film on the metal surface. Reducing the protective properties of the Al_2O_3 oxide film in AN-Al composite fuel can be achieved by alloying aluminum with various metals, such as magnesium. This study presents the results of the influence of the Al-Mg alloy on the combustion efficiency of fuel systems based on ammonium nitrate. Also, it shows the role of copper oxide as an effective stimulator of this process.

Metal alloys are synthesized by high-temperature diffusion welding in an argon atmosphere. The structure and thermal characteristics of alloys are determined by X-ray diffraction (XRD), scanning electron microscopy (SEM), and DTA-TG analyses. It was found that CuO has a significant effect on the thermal decomposition of the AN/MgAl-based energetic mixture, shifting the decomposition temperature from 269.33°C to 261.34°C and decreasing the activation energy from 91.41 kJ mol^{-1} to 89.26 kJ mol^{-1}. The addition of CuO reduced the burning limit by pressure from 2 MPa to 1 MPa. The linear burning rate of the AN/MgAl energetic mixture approximately doubled (r_b = 6.17 mm/s versus r_b = 15.44 mm/s at pressure in chamber P_0= 5 MPa).

Biography

Kamunur K. Born in China in 1988. From 2007 to 2011, he entered the Faculty of Chemistry and Chemical Technologies of Al-Farabi Kazakh National University in the specialty "5B072000-Chemical technology of inorganic substances" and in 2013 in the thing "6M073400-Chemical technology of explosives and pyrotechnic materials" and received his master's degree in 2015. From September 2015 to September 2018, he received a Ph.D. degree from Al-Farabi KazNU, specialty "6D073400-Chemical technology of explosives and pyrotechnic materials". From July 01 to September 02, 2016, Kamunur Kaster conducted dissertation research at Japan Aerospace Exploration Agency (JAXA), Sagamihara, and from September 16 to October 14, 2017 at Nanjing University of Science and Technology (NUST), China. From July 2012 until now, he has been working as a leading researcher in scientific projects in the direction of "Technology development of heat treatment of mineral raw materials" at the RSE "Institute of Combustion Problems", and since September 2019, he has taught at the Department of General and Inorganic Chemistry of the Faculty of Chemistry and Chemical Technology.

DATA-DRIVEN APPROACH TO PREDICT METHODS FOR THE SYNTHESIS OF MOFs ON THE BASIS OF SORPTION PROPERTIES

Ruslan Safaev[1,2] and Knyazeva Marina[1,2]

[1]*Federal State Autonomous Educational Institution of Higher Education "ITMO National Research University"*
[2]*Almetyevsk State Oil Institute, Russia*

Abstract:

Machine learning and deep learning models are increasingly beginning to find practical application in chemical technology. At the same time, there are few studies that take into account the prediction of metal-organic frameworks (MOF) synthesis conditions depending on their sorption properties, especially on the structure-energy characteristics (SECs) calculated by the equations of Dubinin's theory of volume filling of micropores, Kelvin and BET. In this research, a database of reproducible methods for the synthesis of MOF adsorbents and the calculated SECs for them was created. Machine learning models based on gradient boosting on decision trees were applied to predict five synthesis parameters iteratively based on their structure-energetic characteristics. The prediction of categorical parameters such as metal and ligand has been achieved with high accuracy of 0.93 for both, as for numerical parameters such as synthesis temperature, the ratio of salt to acid and the ratio of solvent volume to salt mass the prediction has been achieved with R^2 of 0.78, 0.88 and 0.93 respectively. Finally, k-nearest neighbors algorithm was used to find the nearest neighbors in database based on the predicted synthesis parameters, then the structure-energetic characteristics of neighbors were compared to the same characteristics of desirable MOF that were passed as input to machine learning model. The result has showed us that real structure-energy characteristics would differ in less than 10% from what was passed as input to model. This research can lead to a more efficient and cost-effective process for the production of such materials by reducing time and resource costs of developing the synthesis methods.

Biography

Ruslan Safaev is a second-year master's degree student at the ITMO/ASOI university, AI in biotechnology. He is interested in data science, data analytics and machine/deep learning algorithms. He has expertise in developing and evaluation data science projects, including the concepts and practical usage of machine learning and deep learning models for different tasks. He has been recently implemented data-driven solutions in chemical science and this experience led him to construct the model to predict the MOFs adsorbents synthesis and the other AI models for sorption chemistry during the study.

PROCESS SIMULATION OF CARBONITROTHERMIC SYNTHESIS OF TITANIUM NITRIDE FROM ILMENITE

Refilwe Jenifer Motsoeri, Peter Olubambi, Mojisola and M Ramakokovhu

University of Johannesburg, South Africa

Abstract:

Ilmenite ore is the primary producer of titanium metal, widely used in different industries for its good properties. It is mined as a heavy sand mineral consisting of rutile, zircon, leucoxene, and other trace elements as alluvial deposits deposited by the beach. Processing methods include gravity, magnetic, and electrostatic separation to extract rutile and zircon as by-products. Pyrometallurgical methods further process ilmenite by oxidizing the ore to remove chromium and calcium-bearing minerals, then the phase transition of the ilmenite changes due to temperature change which leads to the formation of pseudorutile and pseudobrookite. The commercial method for reducing this mineral is a carbothermic reduction where the ore (pseudobrookite) is mixed with char and fed to the furnace at high temperatures of about 1600˚C to form titania slag and iron. My project focuses on carbonitrothermic reduction simulation, studying metastable phase formation at low temperatures (below 1000˚C), and generating thermodynamical data for the reactions. The aim is to produce Titanium Nitride powder for the cermet industry for various applications, e.g., Extrusive dies, wear-resistance coatings, cutting tools, and machining.

The study mainly simulates possible phase transitions occurring during carbonitrothermic reduction from temperatures of 200˚-1000˚C, focusing on solid-gas, solid-solid, and solid-liquid reaction formation. Thermodynamic calculations and phase transition at different temperatures were studied using Fact Sage Software 8.1. This ideal simulation indicates possible thermodynamic data missing during the reduction of ilmenite; therefore, exploring ways to capture metastable phase transition suggests ways to improve the process. Powder metallurgy was also introduced in the process with the use of different powders that have characteristics to act as a catalyst.

My research gives a good indication of exploring ilmenite ore, as introducing powders at different ratios with carbon gave good results. Various powders were selected via simulation, and the formation of magneli oxides was indicated at low temperatures as low as 500˚C with the proposed powders Si_3N_4, Mg_3N_2, and NH_4NO_2. Simulations showed that Mg_3N_2 powder is the best as metastable phases start forming, indicating possible thermodynamic quantification of the phase transition of ilmenite. Ternary diagrams for the reactions were studied to indicate ratios of the addition of carbon and powder in the system.

My conclusion is that Mg_3N_2 and NH_4NO_2 indicate good results for studying metastable phase transition, and further study should be carried out on this topic; practical work should be conducted.

Biography

Refilwe Jenifer Motsoeri is a Researcher at University of Johannesburg. She is a Laboratory Analyst at Richards Bay Minerals.

EXPLORING THE IMPACT OF AI IN NANOMATERIAL ANALYSIS AND OPTICAL WAVEGUIDE DESIGN

Cahit Perkgöz and Nail Sengor

Eskisehir Technical University, Turkey

Abstract:

Artificial intelligence (AI) has emerged as a practical problem solver in various scientific and technological domains; notably, the utilization of convolutional neural networks (CNNs) successful in tasks like image processing-involved nanomaterial analysis and optical component design draws attention. However, challenges persist in training such networks due to data intensity and resource limitations. A suitable solution could involve employing artificial intelligence approaches with synthetic and realistic data for training. CNNs are initiated with randomly generated images, aided by certain physical rules, and subsequently fine-tuned with real images, overcoming these constraints and enhancing training efficiency. In this study, we demonstrate the application of AI in both of these areas. In our study, deep CNN methods have been employed for the classification of CVD-grown MoS_2 flakes considering their impact on electronic properties. Artificial microscope images are generated using equations containing physical laws, followed by the utilization of transfer learning. Our work demonstrates the answer to classifying these nanomaterials as defective or defect-free, critical for transitioning into electronic applications, and how it saves time compared to traditionally time-consuming characterization processes. Furthermore, the combination of neural networks and electromagnetic simulation methods not only addresses challenges in nanomaterial research but also benefits the field of optical waveguide design, generating solutions faster than existing design methods. Artificial neural networks containing encoder-decoder structures are utilized in optimum waveguide design, yielding significant results. Similar simulation models are employed to acquire data, which is then used to train AI models in this context as well. The research is supported by the Eskisehir Technical University BAP projects.

Biography

Cahit Perkgoz graduated from Middle East Technical University with a bachelor's and master's degree in Electrical-Electronics Engineering in 1998 and 2002, respectively. Later, he earned his doctoral degree from Hiroshima University in Artificial Complex Systems Engineering in 2005 under the scholarship of the Japanese Ministry of Education (Mombusho). Between 2006 and 2007, he worked as a postdoctoral researcher in the Control and Intelligent Systems Engineering Group within the Electrical and Electronics Engineering department at the University of Hull. From 1999 to 2002, he worked at TÜBİTAK-SAGE, and from 2007 to 2018, he served as an R&D engineer at ASELSAN Inc. Currently, he is a faculty member at the Department of Computer Engineering in the Faculty of Engineering at Eskişehir Technical University. He conducts research in artificial intelligence, deep learning, heuristic algorithms, and nanotechnology. He also contributes to roles like reviewing and monitoring for R&D projects supported by institutions such as the European Union, TÜBİTAK, and KOSGEB.

Day 2

Materials Science Conference 2023

Keynote Presentations

EXTRACTION OF EXTRACELLULAR POLYMERIC SUBSTANCE (EPS) FROM SLUDGE AND APPLICATIONS

P Venkateswara Rao, T Siddharth, P Sridhar and R Satish Babu

National Institute of Technology, India

Abstract:

Urban bodies collect the wastewater and treat it in centralized treatment facilities, which also produces an unavoidable by-product called sludge. Use of synthetic polymers results in excessive sludge and not environmentally friendly. However, biologically produced polymer EPS enhances the aggregation of bacterial cells and suspended solids; moreover, adhesion and cohesion occur between EPS and the organic matter along with suspended solids through complex interactions. In this study, the growth of isolated bacteria from sewage sludge was over observed a period of 24 hours. For sequencing analysis, 200 species were identified, which can be used to extract different EPS harvesting. The phylogenetic tree of multiple bacterial genes are identified and represented. The structural stability of the EPS extracted in the form of pellets is tested for further implementation in various applications. Dry weight quantification of extracted EPS pellets are weighed and in the range of 3.24 g/L-7.96 g/L. Hence, it is recognized extracellular polymer substance (EPS) as a potential biopolymer for its applications for water treatment.

Biography

Polisetty Venkateswara Rao is working as an Associate Professor in the Water and Environment Division, Department of Civil Engineering, NIT Warangal. He obtained his Ph.D. degree in Environmental Engineering from BITS Pilani in 2011. His research interest includes water and wastewater treatment, solid waste management using bioconversion techniques, and renewable energy. Much of his research in waste management has emphasized the availability of biomass to be used as a substrate for anaerobic digestion and its subsequent effective utilization for converting it into biogas.

TREATMENT OF DAIRY WASTEWATER WITH EXTRACELLULAR POLYMERIC SUBSTANCES

R Satish Babu, V Vinila and P Sridhar

National Institute of Technology, India

Abstract:

Dairy industry is one of the largest consumers of fresh water and producer of wastewater. Dairy wastewater has high concentration of organic and inorganic colloidal substances that if not treated properly poses serious threat to the receiving environment. Bacteria-produced polymers called Extracellular Polymeric Substances (EPS), mainly composed of polysaccharides, proteins and uranic acids. Dairy wastewater sludge was used as the source of bacteria for the production of EPS. By 16S rRNA nucleotide sequencing analysis revealed that the bacteria isolated belong to *Stenotrophomonas species*. The flocculating activity of EPS extracted from *Stenotrophomonas koreensis* was found to be 95% at a pH dairy wastewater to be 7 in the presence of Ca^{+2} cation. Optimum dosage of EPS for the treatment of diary wastewater was found to be 8 ml/l at a pH of 7 and flocculating activity of 92.97%. Initial turbidity of dairy wastewater was found to be 1025 NTU. After flocculating with EPS, turbidity was noted as 72 NTU. Initial COD of dairy wastewater was calculated as 954 mg/l and after treatment at an optimum dosage, the treated effluent has COD of 228 mg/l. COD removal efficiency of EPS at an optimum dosage of 8 ml/l, pH of 7, was 76.1%. The high flocculating efficiency, turbidity and COD removal efficiencies of the EPS produced by *Stenotrophomonas koreensis* suggests its application for the treatment of wastewater with high organic (COD and BOD) content.

Biography

R.Satish Babu is working as a Professor in the Department of Biotechnology, NIT Warangal. He obtained his Ph.D. degree in Biotechnology from JNTU Hyderabad in 2013. His research areas include Bioprocess Engineering, Environmental Biotechnology. He is expert in Modeling, Simulation and Optimization of the Bioprocesses.

SELF-GROWN NANOSTRUCTURES FOR ENERGY STORAGE APPLICATIONS

Rajaram S Mane

Swami Ramanand Teerth Marathwada University, India

Abstract:

Nanostructured thin films of metal oxides/ chalcogenides with various morphologies viz., particles, wires, rods, tubes, plates etc., have been significantly envisaged in various optoelectronic devices including thin film transistors, photoelectrochemical cells, heterojunction-based solid-state solar cells, polymer solar cells, gas sensors, dye-sensitized solar cells, batteries and supercapacitors etc. With experience of more than 17 years and 235 peer-reviewed research articles in the journals of international repute, I am actively involved in synthesis of these nanostructures using various solution-processes for designing various devices. To suffice requirements of device, novel structures have been synthesized and successfully evaluated. Since single component metal oxide/form cannot satisfy all essential requisites for a specific optoelectronic device, so emphasis has been made to synthesize property oriented nanostructures to provide a much-needed functionality. For example, when one wish to use metal chalcogenide/oxide as counter electrode like platinum, then synthesized nanostructures of NiS, CoS, FeO_3 etc., should necessarily possess catalytic properties. In this talk, the benefits of solution-processed metal oxide/ chalcogenides nanostructures in the areas of energy (conversion and storage), chemical sensors along with synthesis approach will be discussed. Moreover, biological applications including protective antigen detection and antibiotics in addition to gas sensors and supercapacitors will be highlighted. Attempts will be made to strengthen the application potentiality of acquired skills for indepth understanding through discussions followed by suggestions.

Biography

Rajaram S. Mane received PhD in Physics from Shivaji University, Kolhapur, India in 2000 and worked as a postdoctoral fellow at Hanyang University, Korea. He was also on the research faculty at Oxford University, Oxford, UK. Since 2010, He has been Sr. professor and Director (IIL) at S.R.T.M., University, Nanded, India and a visiting professor at Pusan National University, Korea. With more than 400 research articles, nearly 14000 citations and 292 i10 index, He is actively engaged in the synthesis of 2D and 3D metal oxides/chalcogenides/carbides/nitrides/fluorides for solar cells, electrochemical supercapacitors, chemical sensors and bioactive applications. His major interests include the synthesis of novel nanostructures for energy generation, conversion and storage device technologies in addition to understanding their theoretical behaviors. Finally, He has been nominated as one of the top 2% global research scientists declared by Stanford University USA since 2019 successively.

Day 2

Materials Science Conference 2023

Oral Presentations

FROM FOOD WASTE TO BIODEGRADABLE USEFUL PRODUCTS

Micheline Bejjani

American University, UAE

Abstract:

Plastic is a key material used almost every day and everywhere. Most plastic in use is made of hydrocarbons derived from fossil fuels. It is cheap, easy to process, and has good physical properties. It is though non-biodegradable, thus causing air, soil, and water pollution as well as greenhouse gas emissions. The development of biodegradable plastic is now imperative. The biodegradable products must match the mechanical properties of the conventional ones as well as their chemical resistance. Biodegradable plastics based on carbon derived from renewable materials, including naturally biodegradable food waste, are a potential alternative. In this work, bioplastics made of different combinations of polymers from fruit and vegetable wastes as well as coffee grounds are developed. Their respective mechanical properties, biodegradability, and chemical resistance are studied.

Biography

Micheline Bejjani is an Associate Professor of Engineering Sciences at the American University in Dubai. She has taught many courses including Introductory Physics 1 and 2 with lab, Structure and Properties of Materials, as well as Applied Electromagnetics. Her PhD research was focused on characterizing infrared spectra and structures of small metal-carbon molecules using matrix isolation Fourier transform infrared spectroscopy and density functional theory. She has expanded her research further to nanoscale materials science and is currently working on the development of polymers that are non-toxic, can be composted, and have good mechanical properties in order to replace synthetic non-biodegradable plastics.

EVALUATION OF NEW MATERIAL'S SURFACE MODIFICATION PROCESSES FOR LUNAR DUST MITIGATION IN LUNAR ENVIRONMENT CONDITIONS

Jacob Kleiman

Integrity Testing Laboratory Inc., Canada

Abstract:

ITL developed recently a surface modification process for space-bound materials, including polymers, paints and fabrics that allows to enhance their lunar dust mitigation properties in lunar environment conditions. The interaction of lunar dust and other environmental factors, like vacuum, temperatures, solar radiation, ultraviolet irradiation, and electron (e-) and proton (p+) irradiation with structures on the Moon and the outside of the future Gateway Lunar station may lead to permanent change or complete loss of the thermal, optical, and other functionalities that could potentially lead to catastrophic failures. Among the other factors, lunar regolith dust is the most aggressive, causing the main problems. Several general principles are now being identified to prevent sticking of lunar dust simulant and accumulation on surfaces in vacuum conditions. Through a series of experiments in the ITL-developed Lunar Simulator, ITL demonstrated that it is possible to mitigate accumulation of lunar dust simulant, and enhance surface durability of some important sensitive external structural materials using a developed dust mitigation process that can be applied to space-bound materials that include thermal control materials like Teflon and Kapton, and white paints, and fabrics used for external layers of astronaut's space suits. In the framework of this program, ITL prepared a set of samples with dust mitigation properties for inclusion in the "Regolith Adherence Characterization (RAC) Payload" funded by NASA and developed and built by Aegis Aerospace (formerly Alpha Space Test and Research Alliance).

The goals of the RAC Payload mission are to evaluate several materials and coatings with dust mitigation properties for their ability to repel or shed lunar regolith/dust, (e. g. solar cells, optical systems, coatings, sensors) and to determine regolith accumulation rates: 1) caused by landing, and 2) during routine lander operations. To understand the results of the lunar exposure experiment, we will conduct an extensive set of experiments on interaction of lunar dust simulants with sample surfaces, similar to the RAC Payload experiments on the Moon, in our Lunar Environment Simulator that will be upgraded for this project.

Biography

Jacob Kleiman is the founder and the President and CEO of Integrity Testing Laboratory Inc. a high-tech company whose main mandate is to provide the industrial and scientific community with consulting and analytical services in different aspects of material science. He is also the Founder, President and CEO of Structural Integrity Technologies, Inc. a company specializing on use of low- and high-power ultrasonic technologies for measurement of applied and residual stresses and beneficial redistribution of stresses for fatigue life increase. Prof. Kleiman published over 150 papers and chapters in books on different subjects of his research. He is the author of a number of USA, Canadian, European and Ukrainian patents. He is the editor of the Proceedings series on "Protection of Materials from the Space Environment" published by Kluwer, Springer and AIP Publishing Houses that are based on the biannual series of International conferences that he started in 1991. Prof. Kleiman served as the Chairman of the ASM International, Ontario Chapter in 2000-2001 and is the recipient of the Circle of Technical Excellence Award, Minnesota Mining and Manufacturing Co. (3M), and of the International Pergamon Prize Award for the best paper published in the International magazine "Carbon" in 1983-1984.

2D MATERIALS GROWTH *via* CVD: ADVANCING OPTOELECTRONICS AND ENERGY STORAGE WITH TMDS, GRAPHENE, AND MXene

Nihan Kosku Perkgöz

Eskisehir Technical University, Turkey

Abstract:

In the realm of materials innovation, 2D materials have emerged as promising candidates with vast potential for future applications. This investigation explores the capabilities of chemically vapor deposited (CVD) 2D materials, specifically transition metal dichalcogenides (TMDs), graphene, and MXene, with an emphasis on propelling the fields of optoelectronics and energy storage. Beyond the boundaries of graphene, the domain of 2D materials extends to semiconducting TMDs such as MoS_2, $MoSe_2$, and WS_2, acclaimed for their exceptional optical and electrical attributes. This research spotlights refined growth and transfer techniques enabled by CVD, poised for versatile applications spanning optoelectronics, electronics, and avionics. The exploration encompasses the synthesis of $MoS_{2(1-x)}Se_{2x}$ alloys, ALD-assisted expansion of MoS_2, large-area glass-supported structures comprising MoS_2, WS_2, and $MoSe_2$, as well as the CVD-driven growth of thin MXene films. The rapid energy storage attributes of supercapacitors offer a route to heightened efficiency, affordability, and sustainability within energy storage technologies. Addressing critical challenges, graphene and MXene-based electrodes, obtained by CVD, demonstrate advancements in energy density, cost-effectiveness, and temperature durability. Concurrently, a distinct facet of the study unveils the potential of graphene supercapacitors where the electrodes are realized using rotationally stacked CVD graphene different from other studies. Stacked layers arranged in a rotational manner offer the promise of alleviating restacking issues, thereby facilitating ion intercalation and enhancing their performance in supercapacitor applications. Collectively, our research advances innovative energy storage systems, aligning with renewable energy integration and the objectives of the Green Deal initiative. The research is supported by the TUBITAK project 20AG025 (under 20AG001).

Biography

Nihan Kosku Perkgoz received her undergraduate degree from the Department of Electrical and Electronics Engineering at Middle East Technical University in 1999. She pursued her master's and doctoral degrees at Hiroshima University under the scholarship of the Japanese Ministry of Education (Mombusho). During this period, her developed technique for producing microcrystalline silicon thin films for photovoltaic systems earned her an award from the Japan MRS Society (2003). In 2005, she worked as a postdoctoral researcher at École Polytechnique in France. From 2007 to 2012, she served as a project coordinator at Bilkent University's UNAM. Between 2012 and 2018, she worked as a faculty member in the Department of Electrical and Electronics Engineering at Anadolu University. Since 2018, she has been continuing her research at Eskişehir Technical University. Her research focus includes designing, developing, and demonstrating innovative nanophotonic and optoelectronic devices and sensors structured using semiconductor materials at the nanoscale. Additionally, research is conducted towards the development of innovative materials and systems for energy storage applications such as supercapacitors.

PROTECTION OF REINFORCING STEEL BY "INTELLIGENT" Mg IN CONCRETE

Guang-Ling Song, Lei Yan, Pengpeng Wu and Dajiang Zheng

Southern University of Science and Technology, China

Abstract:

Reinforced concrete infrastructures degrade and the reinforcing steel is corroded rapidly than expected due to carbonation and/or chloride ingress in service conditions. The traditional sacrificial anodes, like Al and Zn alloys, which have been widely used to protect the steel reinforcement could be quickly dissolved due to their amphoteric chemical property in high alkalinity. Mg and its alloys have been measured to sensitively respond to the carbonation and chloride contamination of concrete, and thus they can be made into an "intelligent" sensor to automatically detect the damage degree of reinforced concrete, and meanwhile as a "smart" sacrificial anode to automatically provide adequate cathodic protection for the concrete structure under corrosion attack. This presentation will demonstrate the "intelligence" mechanism of Mg in concrete, compare the different electrochemical behaviors of the "intelligent" Mg alloys and the traditional Al and Zn in simulated concrete pore solutions, present the optimized "intelligent" response of Mg to the chloride contamination through alloying, and discuss possible applications of the "intelligent" Mg anode in marine environments and for a possible carbon dioxide capture, utilization, and storage (CCUS) project in the oil/gas industry.

Biography

Guang-Ling Song is currently a professor of the Southern University of Science and Technology (Sustech), and an Adjunct professor of the University of Queensland (UQ). Meanwhile, he is also a member of editorial boards for Journal of Magnesium and Alloys and Journal of Materials Science and Technology, and acts as an Associate Editor for Anti-corrosion Methods and Materials. He had been working for GM R&D center and ORNL National Lab respectively in USA as a senior staff scientist for many years before he became a university professor. His research interests concern the electrochemistry and degradation of metals in various environments. Prof. Song has published over 300 journal papers, 3 books, and 26 US patents. His publications have been cited over 22,500 times with H-index 70 according to the ISI Web of Science.

Day 2

Materials Science Conference 2023

Poster Presentations

HYBRID SOLID-POROUS DENTAL IMPLANT FOR ENHANCED DRUG DELIVERY FABRICATED USING LASER POWDER BED FUSION

Agnieszka Chmielewska[1,2], Bartlomiej Wysocki[1], Pawel Pacek[1] and Łukasz Żrodowski[3]

[1]*MaterialsCare LLC, Poland*
[2]*The Ohio State University, USA*
[3]*Warsaw University of Technology, Poland*

Abstract:

Dental implants are medical devices for restoring lost teeth and can significantly improve quality of life. However, the complications leading to implant failure might occur soon after implant placement or much later. The phenomenon called periimplantitis is one of the most common reasons for reducing the time of using dental implants while being the most common cause of losing integrated implants. Treatment of this phenomenon is complex, and the prognoses are unfavourable since there are currently no methods of multiple, precise topical administration of drugs to the implant area. Therefore, the possibility of introducing biologically active factors into the direct surroundings of the implant during and after healing is of great interest.

This study aims to develop a screw-shaped dental implant with open porosity and internal channels. The implant's internal channels enable repeated, non-traumatic and direct administration of biologically active agents to the surrounding soft tissues and bone tissue. Moreover, the implant provides the possibility to precisely measure changes in the volume of the bone surrounding and then overgrowing individual structural components of the implant or tissue resorbed around it. This study investigated the influence of LPBF manufacturing on the fine features' printability. Fabricated implants were composed of 3 regions top- solid, mid-porous (with porosity of 200, 500 and 700 μm), and bottom-solid. Various diameters of internal channels in a 0.1-1 mm range were examined. Hybrid solid-porous implants were made from pure titanium and Ti-6Al-4V alloy. Fabrication accuracy was determined by Micro Computed Tomography (μCT), which showed that the accuracy of fabricated channels was comparable between implants made of pure titanium and Ti-6Al-4V alloy. Moreover, the Bone-to-Implant contact area was increased from 13% to 30% for porous specimens compared to solid material.

Biography

Agnieszka Chmielewska earned her Ph.D. in Materials Science and Engineering from the Warsaw University of Technology (WUT) in Poland. Her research is focused on additive manufacturing technologies (aka. 3D printing), most of all laser powder bed fusion and binder jetting. She performs comprehensive computer modelling processes related to additive technologies, starting from the creation of a model of the fabricated element, optimization of support structures, and preparation of batch files for the devices. She has a strong experience with the selection of fabrication parameters for both currently used and new metals and their alloys, as well as the development of post-process treatments, including mechanical, chemical, and electrochemical treatments. She conducts comprehensive material characterization studies using i.e. light microscopy, scanning electron microscopy, computed tomography, and X-ray research methods. She is an expert in CAD modelling based on veterinary and clinical CT data for use in designing and fabricating patient-specific medical devices and surgical guides.

EFFECT OF MECHANICAL ACTIVATION ON THE YIELD OF SUPER-CONDUCTING PHASE OF YBaCuO SUPERCONDUCTOR OBTAINED BY COMBUSTION METHOD

Sergey Fomenko[1], Sanat Tolendiuly[2] and Sovet Aigerim[2]

[1]Laboratory of SHS -New materials, Institute of Combustion Problems, Kazakhstan
[2]AUPET named G. Daukeev, Kazakhstan

Abstract:

The paper presents the results of experimental studies to determine the effect of preliminary mechanical activation of the initial powders (Y_2O_3, BaO, CuO) on the formation of a useful superconducting phase (Y_{123}) in a composite material based on the Y-Ba-C-O system obtained by combustion.Mechanical activation is the process of formation of a substance with greater chemical activity, due to preliminary mechanical processing. Grinding in shock, shock-abrasive or abrasive modes leads to the accumulation of structural defects, an increase in surface curvature, phase transformations, etc., which affects their chemical activity of processed powders. The initial powders were placed in a planetary mill and mixed in an atmospheric environment with a mass ratio of zirconium balls to powders of 5:1 to ensure uniform grinding and activation. The time of mechanoactivations varied from 5 minutes to 60 minutes. Then the mechanically activated mixture was subjected to calcination in a muffle furnace for 6 to 12 hours at a temperature of 910°C - 950°C. After the calcined powders were cold pressed at a pressure of 200 MPa in a steel mold to obtain samples in the form of granules (20 mm by 20 mm). Then the samples were annealed at a temperature of 920°C–950°C for 6–12 h at a heating rate of 2°C/min, then cooled at 1°C/min to 500°C and maintained at this temperature for 6–12 h with continuous flow of oxygen in a tube furnace followed by cooling to room temperature. As a result of the study, it was found that during mechanical activation for 15 - 20 minutes, the highest yield of useful superconducting phase was formed.

Acknowledgement: This research has been funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19677755).

Biography

Sergey Fomenko is an Associated professor, the head of laboratory of SHS -new materials, Institute of Combustion Problems, Kazakhstan. He has over 26 publications that have been cited over 43 times, and his publication H-index is 3 and has been serving as an editorial board member of many reputed Journals in Kazakhstan, Russia and Turkey.

POST-PROCESSING OF TITANIUM DENTAL IMPLANT FABRICATED USING LASER BEAM POWDER BED FUSION (PBF-LB)

Bartlomiej Wysocki[1,2], Agnieszka Chmielewska[1] and Karol Szlązak[3]

[1]*MaterialsCare LLC, Poland*

[2]*Center of Digital Science and Technology, Cardinal Stefan Wyszynski University in Warsaw, Poland*

[3]*Warsaw University of Technology, Poland*

Abstract:

Additive Manufacturing (AM) has recently become a widely used manufacturing technology. When manufacturers opt for AM to produce complex-shaped devices, they need to ensure adequate rendering accuracy and surface quality. During the AM process, powder particles that are not melted adhere to the outer surface of each part. To achieve the desired surface finish, these particles must be eliminated using postprocessing methods. This poses a particular challenge for complexly shaped parts, especially those with closely packed truss structures or channels and open porosity.

To remove particles, the most used mechanical post-processing method is blasting, but it may not be effective enough in porous areas. Hence, chemical and electrochemical polishing methods are often considered. In these methods, the manufactured part is immersed in an acidic solution that dissolves the connections between the unmelted powder particles and the surface. The reagent mixtures and concentrations of reagents may vary based on the material, and the process may also depend on the part's size and geometry.

In this study, a chemical polishing method was utilized to remove unmelted powder particles from the surfaces of porous dental implants with inner channels. The implants were made from pure titanium using the PBF-LB technique. The method involved polishing for a specific time in an HF/HNO_3 solution with a specific composition of HF, HNO_3, and H_2O. It was observed that this method successfully removed all loose and unmelted powder particles. A microcomputed tomography study was conducted, which found that the polished skeletal fixation plates had a volumetric accuracy of 90% compared to the CAD model.

Biography

Bartlomiej Wysocki is an Assistant Professor (MCB UKSW) with experience as a Chief Executive Officer (MaterialsCare) and demonstrated history of working in the medical and additive manufacturing industry. Skilled in various 3D printing techniques (PBF/LB: SLM/DMLS, PBF/EB: EBM, SLA, FDM), electroplating and materials characterisation (microscopic observations, X-ray diffraction, and microtomography analysis). Strong business development professional with a Doctor of Philosophy degree from Warsaw University of Technology focused on materials science and engineering. Currently developing new materials for metal and polymer additive manufacturing technologies at Cardinal Stefan Wyszynski University and transferring the research results from academia to the industry.

SYNTHESIS OF MOF/SILICA CELLULOSE ACETATE MEMBRANES AND CHARACTERIZATION: REMOVAL OF UREMIC TOXINS – UREA AND p-CRESIL

Miguel Minhalma[1,4], Diogo Barradas[1], José Francisco Guerreiro[2], Miguel Silva Pereira[2], Marta Bordonhos[2,3], Moisés Luzia Pinto[2,3] and Maria Norberta de Pinho[2,4]

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[4]Center of Physics and Engineering of Advanced Materials (CeFEMA), Instituto Superior Técnico, University of Lisbon, Portugal

Abstract:

This work addresses the synthesis and characterization of hybrid CA/SiO_2 and CA/SiO_2/MOF membranes envisaging the removal of the uremic toxins - urea and p-cresil sulfate - during hemodialysis treatment. The cellulose acetate membranes where synthetized using the phase inversion method combined with the sol-gel technique.

The Metal Organic Framework, MOF, synthesized - UiO_2-66(Zr) - was added to the casting solutions of the hybrid membranes prepared – CA22, CA22/SiO_2, CA34 and CA34/SiO_2 - containing different amounts of cellulose acetate, acetone and formamide, being the formamide the pore promoter. The membranes with the higher acetone/formamide ratio, CA22 and CA22/SiO_2, have lower hydraulic permeabilities, 1.29 Kg/h/m^2/bar and 4.1 Kg/h/m^2/bar, respectively. The MOF incorporation leads to the increase of their hydraulic permeabilities. This pattern is not verified only for the CA34/SiO_2 membranes. The molecular weight cut-off for the series of CA22 membranes ranges from 2.9 to 28.3 kDa and for the CA34 series ranges from 8.9 to 35.7 kDa. The incorporation of MOF leads to lower apparent rejection coefficients for the two uremic toxins - urea and p-cresil sulfate. For the transmembrane pressure range studied of 0.5-4.0 bar the apparent rejection coefficients of the hybrid membranes are always below 5%.

Biography

Miguel Minhalma, is an Adjunct Professor of ISEL/IPL from 2005. He has a PhD in Chemical Engineering from IST/UTL Portugal. 2002; and a Degree in Chemical Engineering, Processes and Industry branch, by IST/UTL Portugal., 1994. He is an Integrated researcher in Center of Physics and Engineering of Advanced Materials (CeFEMA), IST. Coordinator of the graduate degree in Biomedical Engineering, ISEL, 2023 and Responsible for the Environmental Engineering Laboratory, ISEL, from 2008. Coordinated and participated in research several projects, where its expertise is related to using membrane technology in areas such as process integration, treatment and valorization of wastewaters, production/purification of bioactive compounds and development of hybrid membranes in the development of hemodialysis treatment.

CHARACTERIZATION AND OPTICAL STUDIES OF HYDROXYETHYL CELLULOSE-COPPER OXIDE NANOCOMPOSITES

Abdullah Saad Alsubaie
Taif University, Saudi Arabia

Abstract:

In this study, monometallic copper oxide nanoparticles (CuONPs) were synthesized by chemical reduction of copper sulfate ($CuSO_4$) salt through sugar glucose. X-ray diffraction profiles approved the formation metallic oxide nanoparticles. TEM images showed spherical nanoparticles with average particle size 60nm. The interaction of HEC and cooper oxide nanoparticles was investigated by FTIR spectroscopy. UV–Visible absorption spectrum showed surface plasmon resonance peak at 270nm. Effect of doping of copper oxide CuONPs on optical and thermal properties of HEC was studied. The results showed that concentration of CuO nanoparticles has a prominent influence on optical, structural, and thermal properties of hydroxyethyl cellulose.

Biography

Abdullah Alsubaie is an Associate Professor in Department of Physics, Khurma University College, Taif University, Saudi Arabia. Dr Abdullah is currently a head of physics department. He was awarded his PhD in 2018 from the School of Material science and Engineering at University of New South Wales, Sydney, Australia for work in the field of strain engineering and control of complex oxide materials. His research area is focusing on advanced scanning probe microscopy for the study of physical properties in the forms of thin films, nanomaterials, and nanoscale devices. His research interest including the following: Advanced scanning probe microscopy applied to materials characterisation (AFM, c-AFM, PFM) _ Domain walls and other topological structures in ferroic materials_ Oxide nanoelectronics, interfaces in complex oxides. Dr Abdullah received his MSc in 2012 at Flinders University, Adelaide, South Australia, and his BSc in 2007 at Taif University.

MOF-BASED ADSORPTION SYSTEMS FOR GREENHOUSE GAS CAPTURE: CO_2 AND CH_4

Marina Knyazeva[1,2], Safaev Ruslan[1], Men'shchikov Ilya[1] and Shkolin Andrey[1]

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[2]*Frumkin Institute of Physical Chemistry and Electrochemistry, Russian Academy of Sciences, Russia*

Abstract:

The main problem when using natural gas in various energy installations is the development of systems for storing it in a concentrated state. The most promising among alternative methods of storing and transporting natural gas may be adsorption (ANG). Using special microporous adsorbents, the ANG method can significantly increase the density of methane up to a density close to the density of liquid according to the mechanism of physical adsorption. Besides, adsorption capture and storage of carbon dioxide is an effective way to reduce its concentration in the atmosphere. MOFs are the most promising porous materials for application in adsorption storage systems of different gases including carbon dioxide and methane. MOF samples based on metals such as Cu, Al, Fe, Zr, and organic linkers of 1,3,5-benzenetricarboxylate (BTC) and 1,4-benzenedicarboxylate (BDC). The structural and energy characteristics of the obtained samples were calculated from the isotherms of standard nitrogen vapors at 77 K with the use of a Quantachrome Autosorb iQ multifunctional surface area analyzer. Obtained samples had the following structural-energy properties: specific surface area SBET = 1300-1700 m^2/g; volume of micropores W0 = 0.46-0.67 cm^3/g, average half-width of micropores X_0 = 0.21-0.86 nm. To increase the bulk density, the samples were compacted at various pressures and with the addition of binding components. The adsorption of methane was measured on the high-pressure volume-gravimetric experimental unit in the temperature range from 303 to 333 K and pressures up to 40 MPa and CO_2 in the temperature range from 216.6 to 333 K and pressures up to 120 kPa. As a result, it was shown that one of the most promising materials is Al-BTC MOF, which demonstrated the largest volumetric capacity for methane and Zr-BDC for carbon dioxide.

Biography

Knyazeva Marina has experience in the field of adsorption technologies and the synthesis of porous materials such as MOFs. Her development of synthesis methods and conducting adsorption studies on porous MOFs materials open up new ways to improve environmental problems, namely solving issues of capturing greenhouse gases for the purpose of their further use, as well as improving technology in the energy sector through the effective storage of methane gas in an adsorbed state. She developed this method based on 9 years of experience in research, teaching and working in both a chemical laboratory and in educational institutions. These studies were carried out with the support of leading Russian companies such as Gazprom and Tatneft.

CHARACTERIZATION OF MECHANICAL ANISOTROPY OF ALUMINUM ALLOY BY MEASUREMENT OF THE COEFFICIENT OF LANKFORD

Abuhelo Fadi

University of Science and Technology Houari Boumedienne, Algeria

Abstract:

In 2024 and 7075 Aluminum alloys are mainly used in aeronautic. In many manufacturing Processing, the influence of plastic anisotropy and mechanical properties determine the Formability of Aluminum sheets. The extruded profiles, rolled sheets and other formed Structure presents a plastic anisotropy. The obtained stress-strain curves varied with the plastic anisotropy behavior. Cold rolling strongly affects the Lankford coefficient. The Lankford coefficient has been estimated for Aluminum alloy. In a some Investigation on conventionally rolled sheets, there was good agreement between the Experimental Lankford coefficient and simulated one. However, for the 2024 and 7075 Aluminum alloys, data on the plastic anisotropy after cold working are lacking. Therefore, in the present investigation, the Lankford parameter is estimated from the experimental approach of two important Aluminum alloys namely the 7075 and 2024 ones. The obtained results are compared with those from the literature.

Biography

Abuhelo Fadi is a doctor in physics of materials since 2011 and he obtained my Associate Professor degree in 2019. He has two university books and several national and international articles. He has supervised five masters and now he is a candidate to be a team leader in a laboratory at the Hoauri Boumedienne University of Science and Technology.

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Accepted Abstracts

EXPERIMENTAL INVESTIGATION OF A COMPLEX DIELECTRIC MATERIAL FOR THE INITIATION OF SPACETIME DISTORTION

Chance M. Glenn

The Morningbird Foundation/The University of Houston-Victoria, USA

Abstract:

This presentation introduces an experimental investigation focused on creating nanoscopic spacetime distortions using a complex dielectric material. Our objective is to validate the controlled initiation of spacetime distortion through the introduction of electromagnetic energy within the chosen dielectric environment. We aim to ensure compliance with fundamental force conditions while achieving a positive energy density that triggers controlled spacetime distortion. The successful outcomes of this endeavour could revolutionize propulsion systems for both terrestrial and extraterrestrial travel. Building on Albert Einstein's general relativity and Miguel Alcubierre's metric, we seek to achieve two primary goals: (1) identify and employ the complex dielectric material, either as a direct substance or a metamaterial, and (2) determine the necessary radio frequency power to induce detectable spacetime distortion, substantiated by our proposed

Measurement techniques: Our approach comprises mathematical modeling, comprehensive simulations of diverse ESD apparatus configurations, experimental validation using established laser interferometry, and the publication of results to establish a robust scientific foundation for future advancements. The potential impact of this research is profound, offering fresh perspectives in science, engineering, and technology. By disseminating _findings in educational, scientific, and technical circles, we aim to inspire innovation and expand our understanding of controlled spacetime distortion. This journey delves into uncharted territories, poised to reshape propulsion, space exploration, and our core comprehension of the universe.

TRANSITION METAL-BASED MATERIALS FOR ENERGY STORAGE: MORPHOLOGY, ELECTRONIC STRUCTURE AND APPLICATIONS

Junhua Hu, Jinjin Ban and Guoqin Cao

Zhengzhou University, China

Abstract:

Popularization of portable electronics and electric vehicles worldwide stimulates the development of energy storage devices, such as batteries and supercapacitors, toward higher power density and energy density, which significantly depends upon the advancement of new materials used in these devices. In order to acquire better functionality and performance, advanced energy materials need be satisfied by good electrical conductivity and favorable structures, which can ensure the electronic transfer capability and accelerate the mass transfer. It can be realized by controlling reaction conditions or chemical fabrications. Transition metal-based materials have received tremendous research interest because of their economic benefit, structural tunability, high electrical conductivity, and fascinating electrocatalytic activity. In this talk, we summarized our recent works about the dual design of morphology and defects of transition metal-based materials, mainly including (1) The structure design of cobalt single-atom anchored on nitrogen-doped graphene-sheet@tube, and its application as catalysts in Zn-air batteries. The enhancement of morphological differentiation and structural evolution on catalytic activity will be discussed. (2) The synergistic effects of phase transition and electron-spin regulation on oxygen electrocatalysis boost the intrinsic activity of ternary nitrides. The presence of an intermediate cubic phase induces the formation of Fe_3N with an ideal electronic structure. $(Co_{0.17}Fe_{0.83})$3N@NPC holds electronic configuration with moderate eg electron filling ($t_{2g}5_{eg}{}^{1}$), which balances the adsorption of $*O_2$ and the hydrogenation of *OH. (3) A strategy to introduce low angle grain boundary (LAGB) in Ni/Co layered double hydroxides. Both the formation of hierarchical structure and grain boundaries are interpreted with the synergistic effect of Ni^{2+}/Co^{2+} ratio in an "etching-growth" process, which is also the key point for its enhanced specific capacitance.

BIOINSPIRED LOW WETTABLE MATERIALS: THE CHALLENGE FOR SMART COATINGS AND SCALING UP PROCESSING

Mariarosa Raimondo

Institute of Science, Technology and Sustainability for the Development of Ceramic Materials - National Research Council, Italy

Abstract:

Today, many industries need of innovative and flexible solutions allowing to make of the same bulk material a new multifunctional one, with an improved added value, to be easily integrated in the production lines on a large scale. Wettability against liquids is a fundamental property of a solid surface, whose control plays a key role on industrial ceramic, glass, aerospace, naval, sectors etc. The assessment of the scientific criteria to reduce wetting – related in a complex way to materials' chemico/physical features interacting with the surrounding environments and the contact fluids itself – are among the biggest challenges of innovation in materials' science.

In the last ten years, lot of studies have focused on the possibility of mimicking the outstanding ability of living organisms to repel water and oily substances and mixtures, trying to replicate it on synthetic materials. The basic concepts to design functional materials with a controlled wettability draw inspiration from the perfectly hierarchically organized structures of many living organisms. Current knowledge highlights that contact angle CA>150°C, CA hysteresis lower than 5° and an extremely reduced surface energy are required to produce i.e., self-cleaning, de-icing, anti-fouling, low friction materials, etc.

This lecture will focus on experimental activities relating to the design of amphiphobic metals and alloys, whose surface behaves simoultaneously as superhydrophobic and oleophobic (repellence against low-surface tension liquids). Nano-oxides suspensions with an average particle size < 30 nm, eventually coupled with perfluorinated or fluorine-free lubricant compounds, have been used to modify the material surfaces giving rise to solid-liquid-air working interfaces or, alternatively, to solid-liquid-liquid ones. Dip coating and automated spraying were selected as deposition techniques thanks to their feasibility at industrial level. Optically transparent, homogeneous, nanostructured organic/inorganic hybrid coatings, with a thickness commonly in the 200-300 nm range, have been generated by sol-gel or hydrothermal methods, followed by thermal consolidation and introduction of low energy external layer. CA with water as high as 178°C ± 1°C were obtained, the same materials presenting excellent de-wetting phenomena, as certified by the CA hysteresis lower than 5°C ± 1°C. A full characterization of the surface chemistry was undertaken by XPS analyses, highlighting the different coating's components in the hybrid structure, while FESEM observations allowed to estimate the coating's thickness (300-400 nm) and structuring (flower-like lamellas, agglomeration of spherical nanoparticles, etc). The scaling-up and application of *amphiphobic* materials clamp on their durability under real conditions (i.e., aggressive environments, mechanical stresses, friction effects, etc). Examples of amphiphobic surfaces with adequate durability to wearing, with reduced friction coefficient, anti-icing, de-icing performances, resistance to chemical attacks will be provided, according to the different working scenarios. To date, the performances encourages to think that the planning of innovative *smart* materials, bringing great convenience in strategic industrial processes, it is a feasible task.

DISTRIBUTION OF MOISTURE SORPTION IN EPS THERMAL INSULATION MATERIAL USED IN ETICS KITS

Olena Oleksiienko[1] and Liena Vergun[2]

[1]State Enterprise "State Research Institute of Building Construction", Ukraine
[2]Taras Shevchenko National University of Kyiv, Ukraine

Abstract:

Background: The EPS heat-insulating coatings are used as insulation in external heat-insulating composite systems (ETICS). Determining the EPS moisture sorption is related to the satisfaction of the requirements according to which buildings and structures in operation must meet the normative conditions of human habitation and production and technological processes.

Objective: The establishing of peculiarities of molecules distribution from the gas-air environment at low humidity (40%) and high humidity (97%) in the structure of polystyrene boards EPS of Ukrainian manufacturers

Methods: Equilibrium moisture sorption of EPS samples was tested in artificially created air environments. As a result of the test, the main characteristic obtained was calculated moisture content by mass.

Results: The maximum value of moisture sorption is observed mainly at the initial stage (after 15 days). In the future, this value starts to decrease. The obtained result indicates that there are changes in the studied sample and these changes are associated with the movement of gas molecules that are part of the air. These movements occur until the equilibrium occurs between the concentrations of air molecules, which are in the gaseous environment, and air molecules, which are in the environment of the studied sample. As can be seen from the figures given, at a humidity of 40%, equilibrium is established after about 30 days. And with a humidity of 97% only in about 70 days.

Conclusion: On the basis of test studies of the sorption moisture of EPS plates of Ukrainian manufacturers, it was established that the molecules of the surrounding gas-air environment are arranged according to different schemes for low and high humidity from the outside

It is proposed to introduce an additional assessment criterion, which is related to the placement of air molecules in the structure of polystyrene foam plates

DESIGNING ANTI-RADIATION SHIELD IN EYE CANCER BRACHYTHERAPY

Bartosz Nikiel and Adam Konefał

University of Silesia in Katowice, Poland

Abstract:

Retinal tumors are a major problem for current radiotherapy. These tumors require immediate treatment as they metastasize to the brain area in a short time. The usual method of treatment is surgical removal of the tumor or irradiation of the tumor area with ionizing radiation using brachytherapy. In both cases, the patient loses his sight. An alternative is proton therapy, which allows to maintain vision, but access to it is still difficult. In this work, an attempt was made to improve the brachytherapy of retinal cancer by designing dose-reducing shields in the area of healthy tissues. This work contains considerations on the shields used in eye brachytherapy, the aim of which is to save healthy tissues while maintaining a lethal effect on cancer cells. The research was based on Monte-Carlo computer simulations using the GEANT-4 code. The design of the shields took into account the anatomical details of the eye, the chemical composition and geometry of the shield materials, and the therapeutic dose necessary to destroy the cancer cells. As a result of the research, a shield was designed that effectively reduces the dose to a level that does not cause radiation reactions in the area of healthy tissues surrounding the target area. Currently, the method is being implemented in the clinical practice of the National Institute of Oncology. Maria Skłodowska-Curie in Gliwice.

OPTIMIZATION PARAMETERS OF FRAGMENTARY VOLTAGE AND COLLISION ENERGY FOR IDENTIFICATION AND SEPARATION CARBAMITE ($C_{17}H_{20}N_2O$), FROM OTHER EXPLOSIVES WITH LC / MS-MS.

Milazim Tahirukaj, Blerim Olluri, Andriana Surleva and Herolind Krasniqi

Forensic in Kosovo Agency, Republic of Kosova

Abstract:

Impact statement: This presentation will affect the scientific community of forensics by describing the current capabilities of the Kosovo legal science lab in the development of new methods for the identification and separation of organic explosives by chromatographic methods and the impact on the identification of source (s) explosives and interconnections to identify terrorists.Explosives are classified in several ways, based on different criteria. Thus, the explosives are divided into: high and low explosives based on the type and speed of the action they are doing. Explosives are also classified according to their chemical structure. The most important group is that of organic compounds containing the nitro (NO_2) group. They are further subdivided based on the site where NO_2 is attached to the atomic structure. Nitrogen compounds contain C-NO_2 groups, a group of C-O-NO_2 nitrate ethers and C-N-NO_2 nitrite nitriles.There are different methods for identifying and separating organic explosives, especially Carbamite ($C_{17}H_{20}N_2O$), but recently, double-mass spectrometric detector chromatography has begun to accommodate numerous scientific researches by forensic scientists to find appropriate parameters for the identification and separation of organic explosives in low concentrations in pg (pictograms) or even in fg (fentogram).

Therefore, considering the needs reasonable we have begun to create optimal parameters for CE (collision energy) and FV (fragmentary voltage) for identifying and dividing Carbamite ($C_{17}H_{20}N_2O$) from other explosives by using the Liquid chromatography instrument with double-mass spectrometric detector (LC-MS/MS) with the Atmospheric pressure chemical ionization (APCI) model, Zorbox SB - C18 column 600 bar 3 x 50 mm 3.5 μm and mobile phase: Methanol / Isopropanol / Water (1: 3: 6) as well as 0.1% chloroform.

THERMAL ACTIVATION OF NATURAL SI-RICH MINERALS TO ENHANCE THEIR EFFICIENCY AS SOURCE OF BIOAVAILABLE SI

Elena Bocharnikova

Institute Basic Biological Problems Russian Academy of Sciences, Russia

Abstract:

Silicon(Si)-rich minerals are widely used in agriculture, ecology and restoration of soil fertility. Plant supplementation with bioavailable Si allows the reduction in water irrigation application rate by 40-50%. But natural minerals, such as zeolite, diatomite, perlite, and others are commonly low efficient, resulting in high application rate. The performance of Si-based agrochemicals is largely determined by the supply of active Si forms, primarily water-soluble monosilicic acid. The effect of different modes of heat treatment on the efficacy of zeolite, diatomite, and marl as a source of active Si forms was studied. Heating at 500-700°C provided sharp increase in the water- and acid-extractable Si. The highest increases were observed at 30-min heating at 500°C and 15-min heating at 700°C. A further increase in temperature up to 1000°C or heating time more than 15 min at 700°C led to decreasing active Si. In vegetation test, wheat and grass were grown on sand under water deficiency simulation (50% from optimum) and salt toxicity. Natural and heat-activated zeolites were applied at 250, 500 and 1000 kg ha^{-1}. Activated zeolite increased the biomass of the tested plants by 25-30% under optimum growth conditions and by 60-120% under stressful conditions, whereas non-activated zeolite positively impacted plant growth only at 1 t ha^{-1}. The mechanisms responsible for the effect of activated Si-rich minerals are discussed: a) increasing soil concentration of monosilicic acid, b) enhancing water holding capacity, c) increasing polymeric forms of silicic acid.

DEVELOPING AN INNOVATIVE INTEGRATED GAS WARNING SYSTEM USING THE TRIPLE-CORRELATION ANALYSIS THEORETICAL FRAMEWORK.

Robert M X Wu, Niusha Shafiabady and Ergun Gide

University of Technology Sydney, Australia

Abstract:

Gas explosions and outbursts are the leading types of gas accidents in mining in China with gas concentration exceeding the threshold limit value (TLV) as the leading cause. Current research is focused mainly on using machine learning approaches for avoiding exceeding the TLV of the gas concentration. No published reports were found in the literature of attempts to uncover the correlation between gas data and other data to predict gas concentration. This research develops a Trip-Correlation Analysis Theoretical Framework and aims to fill this gap and develop an innovative gas warning system for increasing coal mining safety. A mixed qualitative and quantitative research methodology was adopted, including a case study and correlational research. An analysis approach - First-round-Second-round-Verification round (FSV) - is developed to verify the robustness of the Trip-Correlation Analysis Theoretical Framework for developing a gas warning system.

The results verify the robustness of the Triple-Correlation Analysis Theoretical Framework. The outcomes imply that this framework is potentially valuable for developing other warning systems. The proposed FSV approach can also be used to explore data patterns insightfully and offer new perspectives to develop warning systems for different industry applications. This informed the development of an Innovative Integrated Gas Warning System which has been deployed for user acceptance testing in Case Mind in 2020.

SHOCK-INDUCED MESOSTRUCTURE SELF-ORGANIZATION

Tatiana A. Khantuleva

Saint Petersburg State University, Russia

Abstract:

Now, it is clear that generally accepted ideas of homogeneity of the shocked material and separation of the stress and strain tensors into elastic and plastic parts are not valid for high-rate deformation. Unlike quasi-stationary processes, high-rate and short-duration processes are accompanied by a complex of post-effects including not only relaxation, but self-organization of dynamic structures on the mesoscale. Inertial effects, displacing dissipation, lead to turbulent motion of the structural elements of the medium. Traces of turbulent motions were experimentally detected even in a solid body after the passage of a shock-induced wave. To describe the process of structure formation on the mesoscale, a new self-consistent non-local approach based on nonlocal and retarded transport equations obtained in non-equilibrium statistical mechanics was proposed. The constructed model of the spatiotemporal correlation dynamics shows that the carriers of deformation on the mesoscale are shock-induced wave packets, which, like mesoparticles, can interact, rotate and unite changing mechanical properties of the material. An explicit approximate solution to the problem of the propagation of a plane shock-induced wave in a solid material is obtained, which describes both the relaxation of an elastic precursor and the plastic front lagging behind it and transferring mass and energy at the mesolevel with a group velocity. Mesostructure formation in the shocked material is described as self-organization in the entropy well where potential energy captured mesoparticles that lost their kinetic energy. Like in quantum mechanics, the remained frozen in the material after the shock-induced wave passage new internal structure has discrete size-spectrum. Mesostructure evolution in a material deformable at a high-strain-rate is described by methods of control theory through feedback, which allows you to control material properties. The proposed approach makes it possible to develop special processing for creating materials with desired properties.

DIAGNOSIS OF PRECANCEROUS LESIONS OF THE GASTROINTESTINAL TRACT DEVELOPING FROM THE ANTERIOR INTESTINE USING HYBRID RECOGNITION AND CLASSIFICATION METHODS

Oleslav Antamoshkin, Semichev Evgeny and Ivan Rozhnov

Siberian Federal University, Russia

Abstract:

Research shows that esophageal cancer always goes through the stages of precancerous lesions, which can be defined as common conditions associated with a higher risk of developing cancer over time. Detecting precancerous lesions before cancer occurs can significantly reduce morbidity and mortality. One of the most common precancerous lesions today is gastroesophageal reflux (gastroesophageal reflux disease, GERD). The prevalence of symptoms (heartburn) of GERD in developed countries reaches 40% of the population. According to numerous clinical and experimental studies, it is GERD that plays a key role in the etiopathogenesis of the development of pathological conditions in the lower third of the esophagus - the transition zone to the stomach. The most serious complication of GERD is Barrett's esophagus or metaplasia (BE), a disease that is a risk factor for esophageal cancer (adenocarcinoma). BE is a condition of the esophageal mucosa with partial replacement of stratified squamous epithelium with metaplastic cylindrical epithelium in the area of the gastroesophageal junction and the distal esophagus.

For a more detailed verification of precancerous conditions of the lower third of the esophagus, modern endoscopic technologies with the taking of histological material are widely used. For the purpose of dynamic monitoring of patients with identified BE, the Prague criteria were developed, which require the mandatory description of anatomical landmarks and determination of the length of segment metaplasia in the distal esophagus according.

Hybrid optimization methods are used to solve the problem of recognition and classification. Such methods are capable of processing various types of data, such as images, video, text, sound and time series. This will further expand the functionality of the system by analyzing the results of other surveys. In addition, hybrid methods are able to recognize complex and nonlinear dependencies between different parameters, which allows accurate detection of precancerous conditions.

LOW RESISTIVE COPPER OXIDE FOR SOLAR CELL APPLICATION

Katarzyna Gawlinska – Necek, Zbigniew Starowicz and Piotr Panek

Institute of Metallurgy and Materials Science, Polish Academy of Sciences, Poland

Abstract:

Copper oxide is a p-type intrinsic semiconductor that mostly occurs in the form of cupric oxide (CuO) with a band gap energy of 1.2 to 2.6 eV, and cuprous oxide (Cu2O) with a band gap of 2.1 to 2.6 eV. Copper oxides are characterized by a high absorption coefficient in a visible range, a high chemical stability, a low price, and a non-toxic nature. For these reasons, they are seen as promising materials for use in different optoelectronic devices, such as heterojunction or perovskite solar cells. There are many methods of CuO_x production, however, the resistivity of manufactured oxide strictly depends on the way of their manufacturing. It should be mentioned that the resistivity of copper (I) oxide typically ranges from 10^1 - 10^4 Ωcm for physical deposition methods and even 10^6 Ωcm for chemical techniques. Therefore, the biggest challenge is to improve the electrical transport properties of copper oxide. A promising strategy is to introduce an efficient dopant to the oxide lattice.

This work aimed to produce a low resistive copper oxide layer with calcium and potassium admixture by spray coating technique. The different concentrations of calcium acetate and potassium acetate were added directly to the precursor solution. It was found that calcium dopant reduced the resistivity of Cu_2O from 21 Ωcm for pristine copper oxide to 12 Ωcm for doped thin film. While potassium admixture reduced it to even 5 Ωcm. The morphologies, optical, and electrical properties of manufactured oxides were studied. Both oxides were deposited on n-type silicon and the I-V parameters of produced heterostructures were measured. The results confirmed that the calcium and potassium are effective admixtures to CuO_x and that developed low resistive copper oxide can be useful for solar cell application.

MULTIPLE STRENGTHENING MECHANISMS IN ADDITIVELY MANUFACTURED COHERENT NANO-PRECIPITATION CONTAINING HIGH ENTROPY ALLOYS

Wang Yilin and Chan Kangcheung

The Hong Kong Polytechnic University, Hong Kong

Abstract:

CoCrNi-based high-entropy alloys (HEAs) with a single face-centered cubic (FCC) structure have received considerable attention in regard to their exceptional ductility. Nevertheless, the low strength of FCC-type HEAs has restricted their widespread applications as structural materials. Nano-precipitation hardening has been proven effective in enhancing the mechanical properties of single-phase HEAs. The performance of coherent nano-precipitation-reinforced HEAs relies on their hierarchical microstructures, especially the distribution and morphology of nano-precipitates. Although prior studies have highlighted the advantages of combined additive manufacturing (AM) and thermal mechanical processing for producing high-performance HEAs, the resulting enhancements in mechanical properties were limited primarily to grain refinement. This study employs a one-step cold-rolling process to modify the microstructural characteristics of the coherent nano-precipitates and further strengthen the as-AMed HEA. AM is effective in fabricating grain-refined alloys with elemental nanoscale heterogeneity. Thus, the as-AMed HEA can serve as a suitable primary material state for further thermal-mechanical processing and facilitate the radical change in nano-precipitation behavior. Modified high-density coherent precipitates divide the FCC matrix into extremely fine nanoscale channels, leading to a significant dynamic Hall-Petch effect during subsequent deformation. Additionally, multiple nanoscale strengthening mechanisms were activated upon deformation, including stacking fault networks and heterogeneity-induced plasticity. Benefiting from the high compositional complexity, the nano-precipitates in this HEA had high deformability and rendered the alloy super-high tensile performance. By carefully controlling the ratio and size distribution of the continuous and discontinuous nano-precipitates, the resulting alloy achieves a superior yield strength of approximately 1.5 GPa. This research incorporated alloy compositional design strategies and AM techniques for tailoring microstructure and multiple strengthening mechanisms. A comprehensive investigation was conducted to elucidate the effect of the modified nanostructures in the alloy and the contributions of alternative strengthening mechanisms.

GROWTH AND CHARACTERIZATION OF THE MAGNETIC TOPOLOGICAL INSULATOR CANDIDATE $Mn_2Sb_2Te_5$

Ankush Saxena and V P S Awana

National Physical Laboratory, India

Abstract:

We report a new member of topological insulator (TI) family i.e., $Mn_2Sb_2Te_5$, which belongs to $MnSb_2Te_4$ family and is a sister compound of $Mn_2Bi_2Te_5$. The TI (Sb_2Te_3) is sandwiched between two antiferromagnetic (AFM) MnTe layers. The crystal structure and chemical composition of as grown $Mn_2Sb_2Te_5$ crystal is experimentally visualized by single crystal XRD (SCXRD) and field emission scanning electron microscopy (FESEM). The valence states of individual constituents i.e., Mn, Sb and Te are ascertained through X-ray photo electron spectroscopy (XPS). Different vibrational modes of $Mn_2Sb_2Te_5$ are elucidated through Raman spectroscopy. Temperature-dependent resistivity r(T) of $Mn_2Sb_2Te_5$ resulted in metallic behavior of the same with an up-turn at below around 20K. Further, the magneto-transport r(T)-H of the same exhibited negative magneto-resistance (MR) at low temperatures below 20K and small positive at higher temperatures. The low T –ve MR starts decreasing at higher fields. The magnetic moment as a function of temperature at 100°C and 1000°C showed AFM like down turn cusps at around 20K and 10K. The isothermal magnetization (MH) showed AFM like loops with some embedded FM/PM domains at 5K and purely paramagnetic (PM) like at 100K. The studied $Mn_2Sb_2Te_5$ clearly exhibited the characteristics of a magnetic TI (MTI).

NEW METAMATERIAL FOR DEW HARVESTING

L. ROYON

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Abstract:

Atmospheric water vapor is ubiquitous and represents a promising alternative to address global clean water scarcity. Atmosphere indeed contains a huge amount of water (12900 km^3). A promising approach is the use of passive radiative cooling materials, which can provide cooling power of 60-150 W/m^2 during night-time applications. We develop new metarial which combine several characteristics to optimize the passive collection of dew water (without energy input and without external intervention), among which: (i) efficient radiative cooling capacities in the atmospheric window, (ii) controlled wetting properties, which favor the nucleation and growth of water droplets (or films), (iii) a geometry at the microscopic and/or macroscopic scale which

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Note:

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